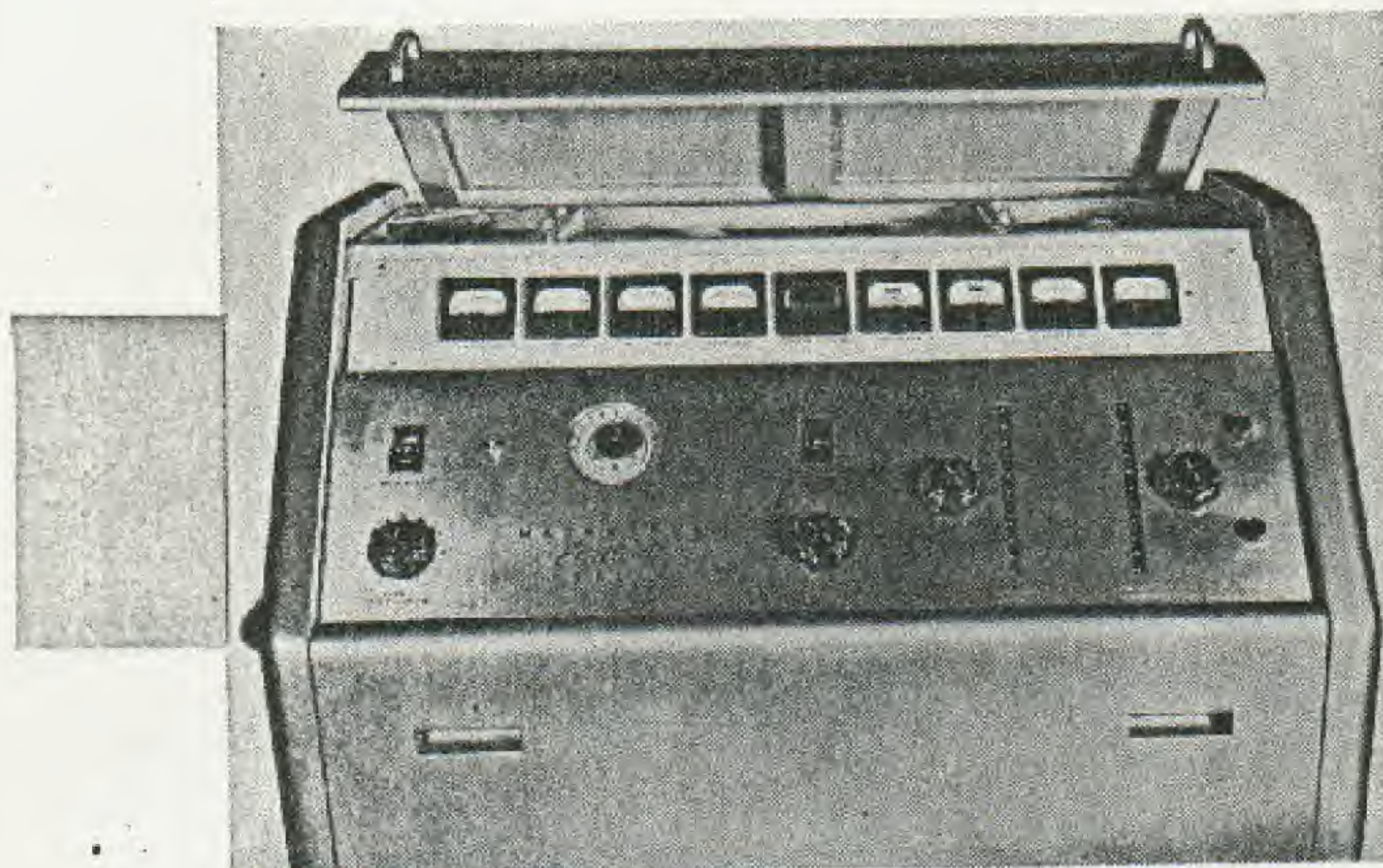


Atomic Energy Beam Rivals Heat of Sun



Control panel and top of the magnetron electronic heater.

MUCH of the atomic energy one hears about is really nucleonic energy—not that it is any less worthy of respect for that reason. On our cover this month is an illustration of *true* atomic energy—energy due to the action of single whole atoms.

The equipment used to produce this energy is a magnetron u.h.f. heater designed by General Electric to operate at 1040 mc, and used chiefly for dielectric heating. It has a water-cooled magnetron with an output power of 5 kw, coupled by a co-axial line to a heating chamber in which the work is normally

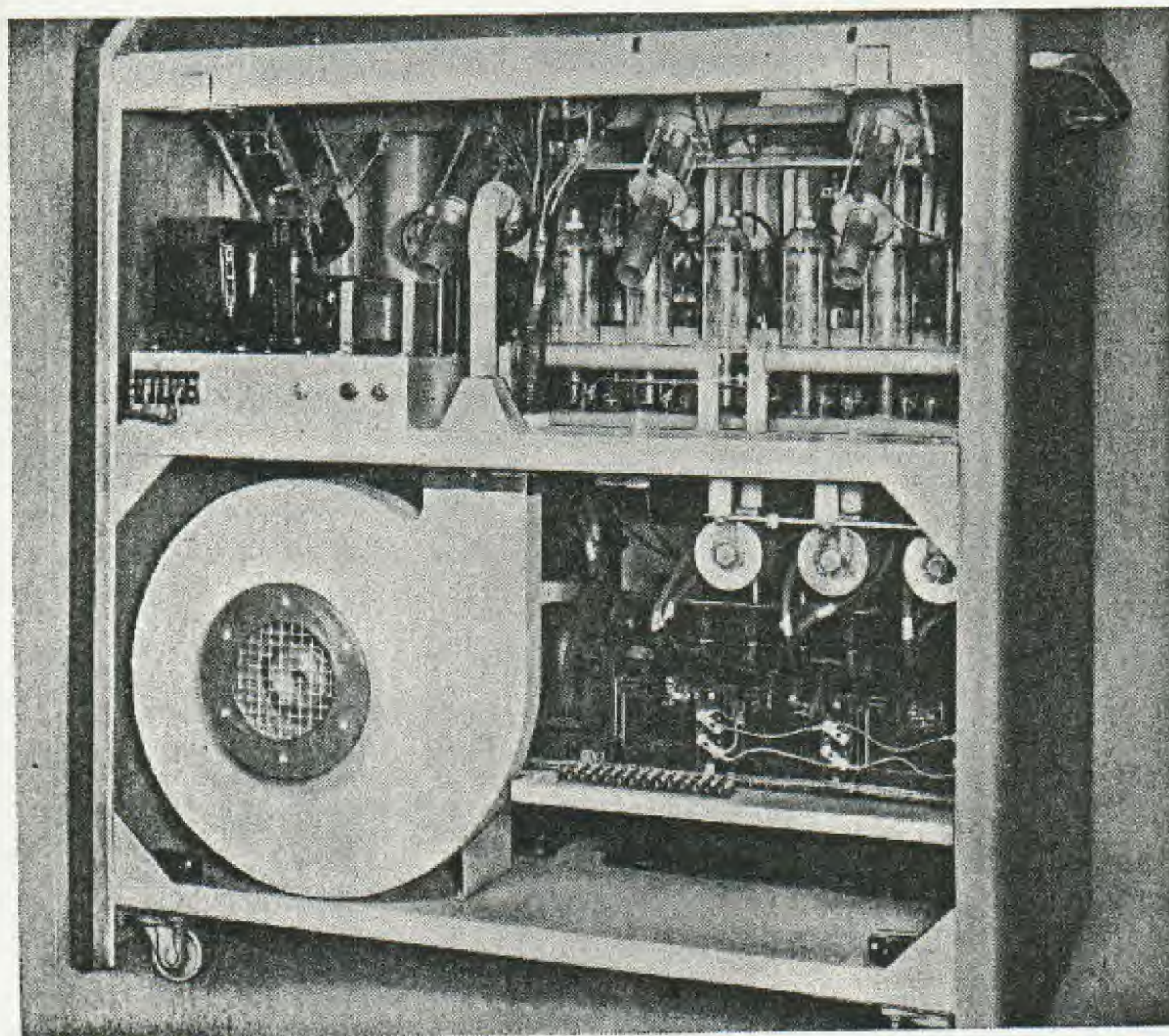
placed. An arc is made to form across the end of the output line. Nitrogen is passed through this arc, and it is the beam of nitrogen gas which forms the atomic blowtorch. Not that the gas is hot—it remains relatively cool till it reaches its work!

The answer to the paradox is simple. Atoms of many types of elements are sociable—they prefer to go around in pairs or groups and are disturbed if forced to separate. In fact, it takes a tremendous amount of energy to pull them apart.

Atoms of nitrogen gas travel in pairs. But the beating they get in passing through the 915-mc, 5-kw arc is more than enough to separate large numbers of them from their partners. They still feel the urge to get together again and do so as soon as they contact any solid object with which they can form molecules. Each time a pair meet again, they give up in the form of heat the energy required to separate them, and in doing so may raise the temperature in the area immediately surrounding them to a very high value. An exact measurement of the highest possible temperature obtainable from the new beam has not yet been made, but the cover picture shows it melting a rod of quartz, which requires 4,118 degrees F. Tungsten, which has a melting point of 6,092 degrees F, has been melted. In tests, it melted not only the metals, but

Photos courtesy General Electric Co.

Rear view of the 5-kilowatt electronic heater, which with the help of a nitrogen stream produces temperatures which can melt such substances as firebrick.



also the firebrick which is used in furnaces.

The stream of gas is not in itself hot—it remains cool until it impinges on some solid substance with which it can form molecules. It is only when the atoms begin to recombine that heat is given out. This can be demonstrated with such absolutely inert gases as argon or neon, which never combine with anything. Passed through the arc, they glow as their electrons are displaced from their orbits, but remain so cool that a hand has been placed in a stream of gas from the arc without ill effects.

There is an important difference between this type of energy and that produced by nuclear action or atomic fission. The energy of fission—once a chain reaction has been started—is supplied by the atoms themselves. The power released in the atomic blowtorch is that supplied by the ultrahigh-frequency beam.

The generator that supplies the power is by no means complex. From the rear (see photo), it looks like mostly blower. The tube itself is water-cooled, and the blower simply cools the output seal. To the right of the blower are transformers for the filament supply. Filament temperature control equipment is in the upper left corner. Elaborate controls are necessary on high-power magnetrons, as the filament temperature depends not only on the current supplied by the filament transformer, but also upon the plate current and the match to the load. If a great deal of power is reflected back to the tube, filament temperature increases. Normal filament current is 53.5 amperes at 10.5 volts—over 500 watts for the heater alone.

The six plate-supply rectifiers are seen along the shelf at the top. The Z-1492 magnetron uses 2 amperes at 5,000 volts. The tube itself is directly behind the blower, but the co-axial output line may be seen ascending in the upper left, behind the filament control equipment.

No circuit is given, as the fundamental circuit is simply that of a diode with a piece of co-ax running out of it. Two directional couplers (see RADIO-ELECTRONICS, December, 1948, page 26)—one to measure the power going down the co-ax from the tube and the other to measure any power reflected back from the load—are connected to the co-ax and show whether the equipment is operating normally. While there is a considerable amount of auxiliary apparatus, it is associated either with the power supplies or with the control and safety circuits, and is therefore of much more interest to the technician maintaining the set than to anyone else.

The uses of the new equipment have not yet been thoroughly explored. As a new and convenient source for extremely high temperatures, it will no doubt open up new fields for itself as well as facilitate present processes which require use of particularly high temperatures.

Electronics Detects Cancer With Vacuum-Tube Voltmeter

ONE of the latest marriages between electronics and medicine has resulted in the conception of a new method of detecting malignant tissue in the body, particularly that caused by cancers.

Developed by Drs. Harold S. Burr of Yale University and Louis Langman of the New York University College of Medicine, the technique measures the minute electrical potentials developed by body tissue. These researchers have found that healthy tissue generates a positive voltage, while malignancy is indicated by negative readings. So effective are the polarity indications that in tests with 428 female patients at New York's Bellevue Hospital, 81.9% of those proved healthy by other methods showed the positive reaction, while 98.7% of those known to have cancers gave negative indications. These percentages of correctness are higher than are obtainable with any other comparable test.

While negative readings do not always indicate cancer—certain other conditions, such as pregnancy, ovarian cysts, and fibroid tumors will also cause negative potentials—they do at least warn the physician that further tests are advisable.

The tests have been made so far only on women patients to detect cancer of the genital tract. Vaginal electrodes were made by filling the interior of shallow-S-shaped Lucite tubes with paraffin after inserting silver-silver-chloride wire, which projects slightly at one end. The protruding end of a wire is covered by gauze or cotton soaked in a saline solution, a precaution to prevent contact potentials from developing between the electrode and the body.

The reference electrode is another similar wire wrapped in saline-soaked cotton or gauze, held in a Lucite cup with a handle of the same material.

The minute potentials generated by the section of the body tested are measured by a bridge-type, vacuum-tube microvoltmeter, the schematic of which appears on this page. A single 2C21 is used in a cathode-follower circuit. By shorting the input with the switch, and adjusting the 10,000-ohm cathode rheostat, the instrument can be balanced exactly at free grid potential. This is an absolute necessity; the balance is aided, along with stability, by a voltage-regulating transformer at the input to the power supply.

The output of the bridge is connected to a photoelectric galvanometer which

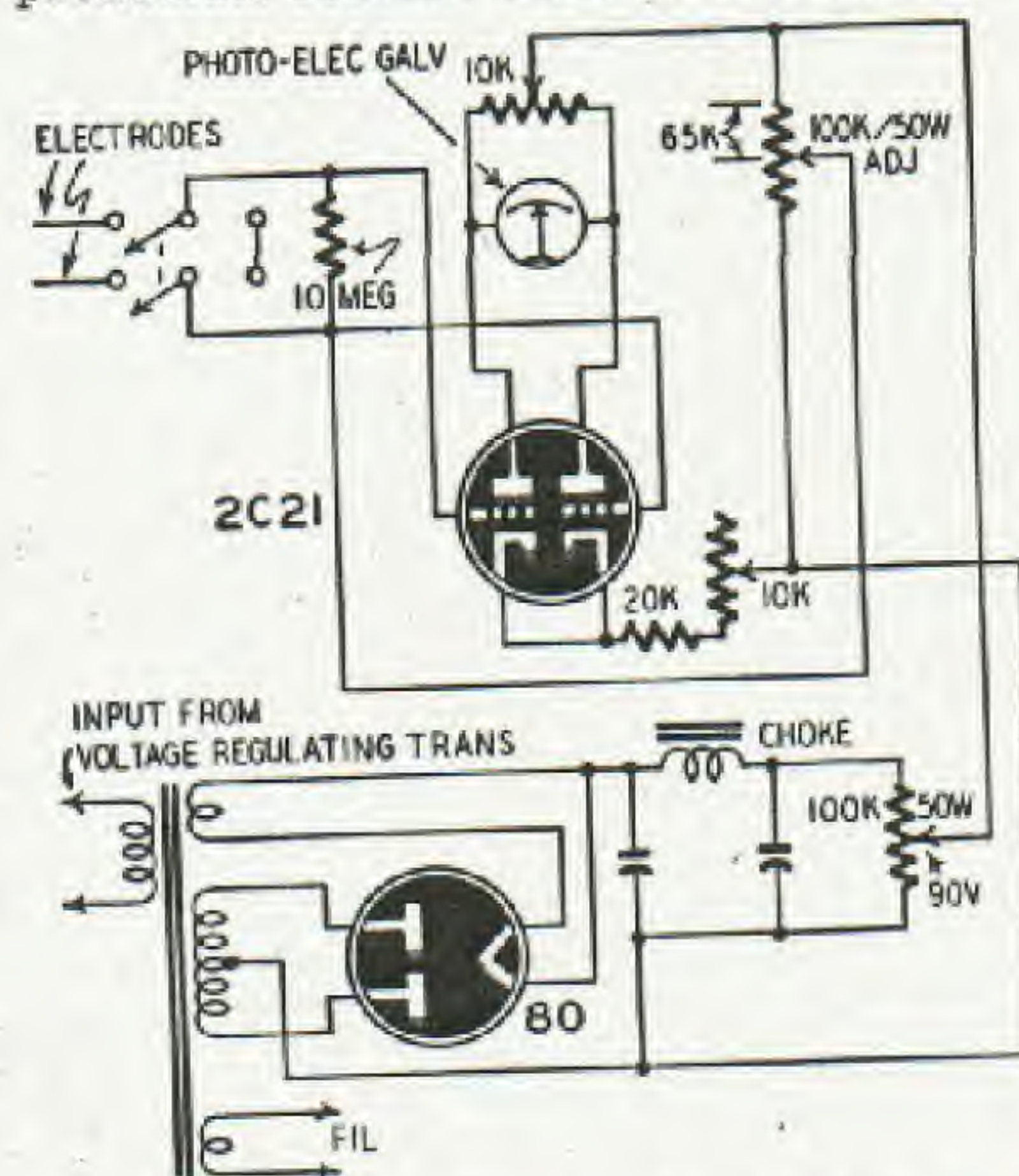
makes permanent records of the patient's voltages on a moving paper. The basic movement of the galvanometer is 3 μ a, but sensitivity can be set at other points by adjusting a 10,000-ohm potentiometer which may be placed between the galvanometer and the bridge.

Because of the bridge arrangement, readings (tracings on the moving tape) show the polarity of the input voltage—the important point—as well as its amplitude.

In operation, the vaginal electrode is introduced into the patient, with the protected tip in the posterior fornix of the vagina against the cervix. The reference electrode is bandaged to the abdomen.

The potentials are measured for 15 minutes to a half hour. At the start, there is often a drift, either negative or positive, but for the rest of the run, the readings remain surprisingly constant.

Due to the newness of the technique and the extremely small potentials involved, many precautions are necessary and much experience must precede reproducible results. Once mastered, how-



The equipment. Diagnosis is made on a basis of the polarity of the readings.

ever, this new method of detecting cancer is comparatively simple to use. Because today's knowledge permits effective treatment of cancer only in its early stages, quick detection is the greatest hope for recovery.

Interested physicians will find somewhat more detail (especially of the purely medical variety) in the report written by Drs. Langman and Burr in the February, 1949, issue of the *American Journal of Obstetrics and Gynecology*.